

THE UNIVERSITY OF KANSAS SCIENCE BULLETIN

VOL. XLVI

PAGES 717-751

DECEMBER 2, 1966

No. 20

The Classification of the Diphaglossinae and North American Species of the Genus *Caupolicana* (Hymenoptera, Colletidae)¹

By

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ABSTRACT

This paper describes and provides keys for the tribes of the apoid subfamily Diphaglossinae. One of the tribes, the Caupolicanini, is treated in greater detail, its genera being characterized. The subgenera of one of the genera, *Caupolicana*, are characterized, as are the North and Central American species of the genera *Caupolicana* and *Crawfordapis*. Two new subgenera, *Caupolicanoides* and *Alayoapis*, and one new species, *Caupolicana ocellata*, are described. *Crawfordapis* is given generic rank while *Zikanapis* is reduced to a subgenus of *Caupolicana*.

Most species of the Caupolicanini are active primarily in the early morning and sometimes late evening hours. Some have enlarged ocelli, presumably related to such a time of flight.

This paper consists of (A) brief descriptions of the tribes of the colletid subfamily Diphaglossinae, (B) descriptions of the genera of the tribe Caupolicanini, (C) a subgeneric classification of the genus *Caupolicana*, and (D) an account of the North American (including Central American and Antillian) species of that genus and *Crawfordapis*.

A. THE TRIBES OF DIPHAGLOSSINAE

The Diphaglossinae is a group of large to very large colletid bees limited to the Western Hemisphere. It contains the Diphaglossinae plus the Caupolicanini of Michener (1944); Moure (1945) has united these groups, a viewpoint in which I have agreed (e.g., Michener, 1954). Moure (1945, 1953) divides the subfamily into tribes which may be separated as follows:

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KEY TO THE TRIBES OF DIPHAGLOSSINAE

1. Pre-episternal groove complete; first flagellar segment much longer than others, petiolate, nearly as long as to longer than scape. *Caupolicanini*
 — Pre-episternal groove absent below scrobal groove; first flagellar segment not greatly longer than others, not petiolate, much shorter than scape. 2
2. Notauli represented by deep grooves in anterior part of mesoscutum; malar space over one third as long as eye. *Diphaglossini*
 — Notauli weak or absent; malar space short or absent. 3
3. Arolia present. *Mydrosomini*
 — Arolia absent. *Ptiloglossidiini*

TRIBE CAUPOLICANINI

1. Lower part of face short, malar space short or absent. 2. First flagellar segment much longer than other segments of flagellum, nearly as long as to longer than scape, petiolate. 3. Notauli strong. 4. Pre-episternal groove complete. 5. Jugal lobe of hind wing over three fourths as long as vannal lobe and extending beyond cu-v. 6. Second submarginal cell much shorter than 1 or 3; first recurrent vein approximately interstitial with first transverse cubital. 7. Second recurrent vein more or less continued in same direction as Cu₁. 8. Distal parts of wings hairless, strongly papillate, but papillae often ending in slender hairlike points. 9. Arolia present.

This is the most distinctive tribe of the Diphaglossinae, as indicated by characters 2, 4, 5, 6, 7, and 8 above.

Genera included in the Caupolicanini are *Caupolicana*, *Ptiloglossa*, and *Crawfordapis*. They range from North Carolina, Kansas, and Arizona to Argentina and Chile.

TRIBE DIPHAGLOSSINI

1. Lower part of face elongate, malar space over one third as long as eye. 2. First flagellar segment not greatly longer than others, not as long as scape, not petiolate. 3. Notauli strong. 4. Pre-episternal groove absent below scrobal groove. 5. Jugal lobe of hind wing less than half as long as vannal lobe and not reaching level of cu-v. 6. Submarginal cells decreasing in length from 1 to 3, rarely 2 and 3 equal; first recurrent vein entering second submarginal cell more or less medially. 7. Second recurrent vein at a distinct angle to Cu₁. 8. Distal parts of wings with hairs, not strongly papillate. 9. Arolia present.

This tribe is related to the following tribes as shown by characters 2, 4, 5, 6, 7, and 8; however, it also shows some relations to the Caupolicanini, indicated especially by its similarly large and robust form and by character 3.

Genera included in the Diphaglossini are *Diphaglossa*, *Cadeguala*, and *Policana*, all of which are Chilean.

TRIBE MYDROSOMINI

1. Lower part of face short, malar space short or absent. 2. First flagellar segment about as long as apical one and less than half as long as scape (female) or much shorter than any others and under one fourth as long as scape (male), not petiolate. 3. Notauli absent. 4. Pre-episternal groove absent below scrobal groove. 5. Jugal lobe of hind wing about half as long as vannal lobe and not reaching level of cu-v. 6. Submarginal cells decreasing in length from 1 to 3 or 2 and 3 about equal; first recurrent vein entering second submarginal cell at base or in basal third. 7. Second recurrent vein at a distinct angle to Cu₁. 8. Distal parts of wing with hairs, not strongly papillate. 9. Arolia present.

Genera included in the Mydrosomini (Moure's Dissoglottini) are *Mydrosoma* (= *Apista* = *Egapista* = *Dissoglotta*) and *Bicornelia*. They occur in tropical America from Mexico to Brazil.

TRIBE PTILOGLOSSIDIINI

I have not seen specimens of this tribe; the following information, organized to parallel that for the other tribes, is from Moure (1953), who gave an excellent account of the group.

1. Lower part of face short, malar space short. 2. First flagellar segment considerably shorter than scape, shorter than (male) or equal to (female) flagellar segments 2 + 3, not petiolate. 3. Notauli practically absent. 4. Pre-episternal groove absent below scrobal groove. 5. Jugal lobe of hind wing over half as long as vannal lobe and nearly reaching level of cu-v. 6. Second submarginal cell shorter than 1 or 3; first recurrent vein entering second submarginal cell almost medially. 8. Distal parts of wings with hairs, not strongly papillate. 9. Arolia absent.

The only genus of Ptiloglossidiini is *Ptiloglossidia* from Argentina. I suspect that it should be included in the Mydrosomini but not having seen specimens, I retain the Ptiloglossidiini for the present. Character 9 is the only strikingly distinctive feature.

B. THE GENERA OF CAUPOLICANINI

The Caupolicanini is divisible into two large genera and one small one, *Crawfordapis*, as shown below.

KEY TO THE GENERA OF CAUPOLICANINI

Outer hind tibial spur of male immovably fused to tibia; hind basitarsus of female less than twice as long as broad, second hind tarsal segment broader than long; metasomal terga usually weakly metallic bluish or greenish.
 *Ptiloglossa*

- Outer hind tibial spur of male articulated at base; hind basitarsus of female more than twice as long as broad, second hind tarsal segment longer than broad; metasomal terga usually nonmetallic. 2
2. Seventh sternum of male with no paired apical lobes; base of marginal cell prolonged as narrow sinus to apex of stigma. *Crawfordapis*
- Seventh sternum of male with paired apical lobes; base of marginal cell not prolonged as narrow sinus. *Caupolicana*

Genus *Ptiloglossa* Smith, 1853

Ptiloglossa (including the subgenus *Ptiloglossodes* Moure, 1945) can be distinguished from the rest by the following combination of characters:

1. Clypeus clearly elevated above level of adjacent parts of face, extending high on face so that in female clypeoantennal distance is usually distinctly less than diameter of antennal socket.
2. Stigma often only half as long as prestigma, sometimes (*Ptiloglossodes*) two thirds as long as prestigma; marginal cell, except in *Ptiloglossodes*, prolonged basally as narrow sinus to apex of stigma.
3. Hind basitarsus of female less than twice as long as broad. Second and third hind tarsal segments of female broadly expanded above, each, or at least second, broader than long.
4. Outer hind tibial spur of male immovably fixed to tibia, its broad base gradually expanding onto the tibia so that sharp line between spur and tibia does not exist (outer spur entirely absent in male *Ptiloglossodes*).
5. Abdominal terga with metallic bluish or greenish tints (except in one Mexican species, *P. wilmattae* Cockerell).
6. Lateral extremities of fourth and fifth terga of male extending ventrally, usually more than other terga, broadly overlapped by sterna of preceding segments, and densely covered by short erect hair of uniform length, these areas under low magnification appearing dull and scarcely punctate in contrast to adjacent areas.
7. Sixth sternum of male with posterior margin thick, thickest medially where there is usually a weak mid-apical angle, a sulcus at each side in margin, facing posteriorly; carina which delimits lower margin of sulcus projecting ventrally at each side as thorn-like spine (except in *Ptiloglossodes*).
8. Seventh sternum of male with two pairs of apical lobes, both large, broad distally, narrowed basally, the upper pair long pedunculate with a process arising near middle of peduncle (for ventral views, see Michener, 1954).
9. Eighth sternum of male with apical process translucent light brown, strongly curved down apically, with long hairs on dorsal surface.
10. Gonoforceps ending bluntly.

Ptiloglossa is a primarily tropical genus, although a few species reach southern Texas and Arizona in the north and Argentina in the south. The genus does not occur in Chile.

Genus *Crawfordapis* Moure, 1964

The name *Crawfordapis* was originally proposed as a subgenus of *Zikanapis* but the single Middle American species seems so distinctive that

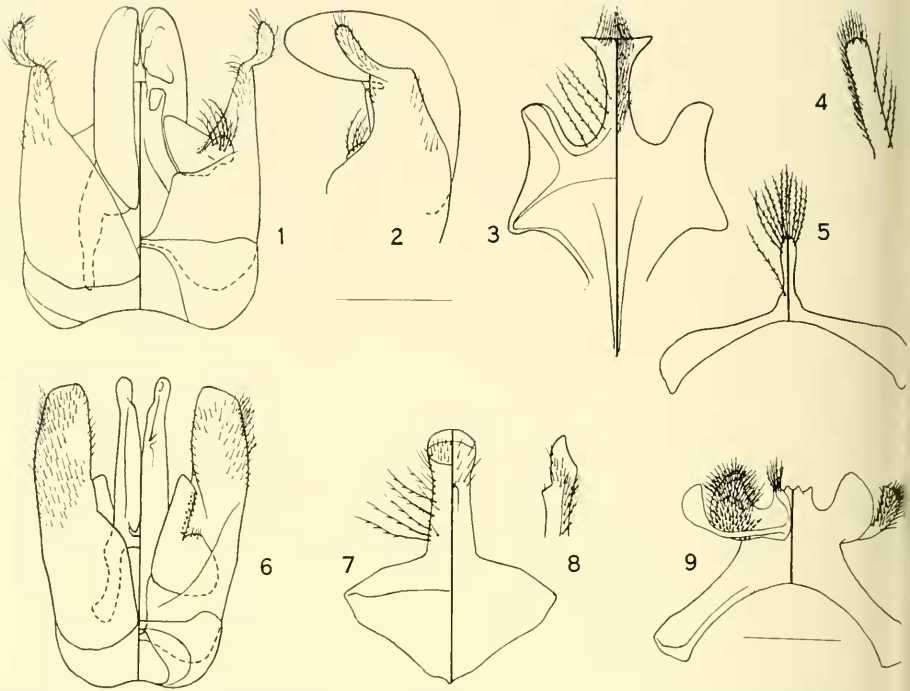
generic rank is warranted for it, even though *Zikanapis* is here considered a subgenus of *Caupolicana*, *Crawfordapis* is especially distinctive in characters 8 and 10 described below. Characters 1 and 2 are *Ptiloglossa*-like as is part of 3 (expanded second and third tarsal segments of female), and in general, 5. Characters 4, 6, 7, and 9 are more or less *Caupolicana*-like. As shown in the illustrations, there are various other distinctive features of the genitalia and sterna but the external features are very much like those of *Caupolicana*.

1. Clypeus clearly elevated above level of adjacent parts of face, as in *Ptiloglossa* but more strikingly so. Clypeus extending rather high on face, nearly as in *Ptiloglossa*. 2. Stigma less than half as long as prestigma; marginal cell prolonged basally as a narrow sinus to apex of stigma. 3. Hind basitarsus of female more than twice as long as broad. Second and third hind tarsal segments of female considerably expanded above but longer than broad. 4. Outer hind tibial spur of male normal, articulated at base like inner spur. 5. Abdomen without or with exceedingly weak bluish or greenish tints in male, with distinct blue tints in female. 6. Lateral extremities of terga of male without areas of short, dense, erect hair. 7. Sixth tergum of male with posterior margin not thickened or sulcate, medially produced and slightly bifid as in *Zikanapis*. 8. Seventh sternum of male without paired lobes but with median, apical, slender hairy process. 9. Eighth sternum of male with apical process rather heavily pigmented, not downcurved, hairs of distal half shorter than width of process. 10. Gonoforceps ending in slender styluslike structures, therefore perhaps with distinguishable gonocoxites and gonostyli (Figs. 1-5).

Genus *Caupolicana* Spinola, 1851

This genus is here interpreted in a broad sense to include the species placed in recent years in *Zikanapis* and *Willinkapis*. *Zikanapis* in particular is, however, a distinctive group which may well merit generic recognition, as is *Caupolicanoides*. The following characters separate *Caupolicana* from *Ptiloglossa*.

1. Clypeus less elevated above adjacent parts of face than in *Ptiloglossa*, profile of supraclypeal area often a continuation of that of clypeus. Clypeus not extending so high on face as in *Ptiloglossa*, so that in female clypeoantennal distance is at least as great as diameter of antennal socket. 2. Stigma slightly more than half as long as prestigma to as long as prestigma; base of marginal cell not prolonged as a narrow sinus to apex of stigma. 3. Hind basitarsus of female more than twice as long as broad. Second and third hind tarsal segments of female but little expanded above, longer than broad. 4. Outer hind tibial spur of male normal, articulated at base like inner spur. 5. Abdomen without bluish or greenish tints (except in *Willinkapis*). 6. Lateral extremities of terga of male without areas of short, dense, erect hair of uniform length



FIGS. 1-5, *Crawfordapis luctuosa*, male (specimen from the type series of *crawfordi* from Costa Rica). 1, genitalia; 2, lateral view of apical part of genitalia; 3, eighth metasomal sternum; 4, lateral view of apical process of eighth metasomal sternum; 5, seventh metasomal sternum.

FIGS. 6-9, *Caupolicana* (*Caupolicanoides*) *pubescens*, male (specimen from Concepción, Chile, labeled as "typus" of *herbsti* by Friese, USNM). 6, genitalia; 7, eighth metasomal sternum; 8, lateral view of apical process of eighth metasomal sternum; 9, seventh metasomal sternum.

The genitalia and sterna are illustrated with the dorsal views at the left, ventral views at the right. The lateral views of genitalia and of the process of the eighth sternum are with the dorsal side at the right. The scale lines for each species represent 1 mm.

except in *Zikanapis*, where such areas are more extensive than in *Ptiloglossa*. 7. Sixth sternum of male with posterior margin not thickened or sulcate, if somewhat thickened, not thickest in middle; no thornlike spines. 8. Seventh sternum of male with upper pair of apical lobes straplike or sometimes broadened distally, without a median process on the peduncle except in *Alayoapis* (of course peduncle not recognizable when lobes are straplike, but no process in any event). Lower pair of apical lobes not or scarcely narrowed basally (except when broadly bifid as in *C. yarrowi*), often reduced so as to be almost unrecognizable or absent. 9. Eighth sternum of male with apical process heavily pigmented, not strongly curved down apically, hairs of distal half of process shorter than width of process. 10. Gonoforceps ending bluntly.

Caupolicana is a genus best represented in warm temperate and subtropical

regions of both North and South America but poorly represented or absent in the intervening tropical zone. The majority of the described species are from Chile.

C. SUBGENERA OF CAUPOLICANA

The genus *Caupolicana* can be divided into several groups, as is indicated below.

KEY TO THE SUBGENERA OF CAUPOLICANA

1. Stigma slightly broader subapically than basally; marginal cell large, little over four times as long as wide (Fig. 10). *Caupolicanooides*
 — Stigma parallel sided or tapering apically; marginal cell slender, five to six times as long as wide (Fig. 12). 2
2. Metasomal terga rather weakly metallic bluish; ventral apical lobe of seventh sternum of male probably represented by broad, apically rounded, laterally directed, heavily sclerotized lateral apical projection which is hairless except mesally. *Willinkapis*
 — Metasoma nonmetallic; ventral apical lobe of seventh sternum not heavily sclerotized, not hairless, variable in size and shape but not as above, sometimes absent. 3
3. Sixth sternum of male with apex rounded, rarely with broad median, V-shaped notch but no produced region; lateral extremities of terga 2-4 without specialized regions; clypeus of male not over 0.76 times as long as wide. 4
 — Sixth sternum of male with weak median apical projection which has a broad median, V-shaped notch; lateral extremities of terga 2-4 of male with large areas of dense short hair of uniform length; clypeus of male about 0.85 times as long as wide. *Zikanapis*
4. Inner orbits of male strongly converging above in male, ocellular distance one fourth of an ocellar diameter or less. *Alayoapis*
 — Inner orbits not or weakly converging above in male, ocellular distance over one third of an ocellar diameter and usually nearly equal to an ocellar diameter. *Caupolicatna s. str.*

Subgenus *Caupolicana* Spinola

(Figs. 12-29)

Caupolicana Spinola, 1851, in Gay, Historia fisica y politica de Chile, Zool., 6:212.

Type species: *Caupolicana gayi* Spinola, 1851, designated by Sandhouse, Proc. U.S. Nat. Mus., 92:534.

Megacilissa Smith, 1853, Catalogue of the hymenopterous insects in the collection of the British Museum, 1:123.

Type species: *Megacilissa superba* Smith, 1853, = *Caupolicana fulvicollis* Spinola, 1851 (monobasic).

1. Inner orbits slightly converging above (subparallel in *ocellata*, rather strongly converging in *mystica*); ocellular distance usually slightly less than

ocellar diameter (slightly more than in *dimidiata*, about two thirds of an ocellar diameter in *mystica* because of unusually convergent eyes, less than half an ocellar diameter in *ocellata* because of enormous ocelli). 2. Clypeus of male 0.70 to 0.76 times as long as wide. 3. Scape of male usually less than three times as long as wide, about three times as long as wide in *adusta*, *quadri-fasciata*, and *hirsuta*. 4. First basitarsus of male straight to slightly arcuate, as long as or slightly shorter than remaining tarsal segments together. 5. Hind tibia of male straight to arcuate. 6. Basitibial plates of male indicated only on posterior margin, or complete in *adusta*, *quadrifasciata*, and *hirsuta*. 7. Hind basitarsus of male four to five times as long as wide. 8. All femora of male with abundant long hair except middle and hind femora of *electa*, *ocellata*, and *yarrowi* which have only sparser, shorter hair; base of middle femur of male with area of short, often rufescent hair (this area absent in *ocellata*, small in *yarrowi*, but unusually large in *electa*). Front femur variable in thickness. 9. Stigma parallel sided or slightly narrower apically than basally, discal area narrower than or as wide as marginal thickenings; first submarginal cell shorter than to longer than second and third together (first on posterior side shorter than or equal to second and third together); marginal cell narrow, five to six times as long as wide; cell 1st M 2.72 to 3.61 times as long as broad; first recurrent vein shorter than or equal to posterior margins of second and third submarginal cells together, the latter shorter than or nearly equal to first abscissa of vein Cu_1 (i.e., posterior margin of cell 2nd M). 10. Pubescence, at least that of metasoma, partially black; terga with apical bands of white hair, sometimes much reduced (*albiventris*, *adusta*, *electa*) or absent (*dimidiata*, female of *funebri*); sterna two to five of male usually with unusually dense long hair (not or scarcely true of North American species). 11. Metasoma nonmetallic. 12. Terga of male without lateral areas of short erect hair. 13. Sixth sternum of male with long hairs or with discal area of short hairs; posterior margin usually rounded, sometimes (*ocellata*, *hirsuta*) notched medially suggesting *Zikanapis* and *Willinkapis*; some species with a pair of preapical lobes (*gayi*, *dimidiata*, *vestita*, *piurensis*; *fulvicollis* has weak suggestions of the same lobes); surface hairs reaching posterior margin of sternum. 14. Dorsal apical process of seventh sternum moderately robust (very slender in *yarrowi*), not or only weakly spatulate and usually with only sparse, short hairs (but with long hairs in *quadrifasciata* and *hirsuta*); ventral apical process distinctly projecting, hairy, sometimes quite large (largest in *quadrifasciata* and *hirsuta*).

The subgenus *Caupolicana* proper is the largest unit of the genus. The diversity among the species results in forms closely approaching *Caupolicanoides* and is discussed in connection with that subgenus.

Included species that I have studied are: *adusta* Friese, 1899; *albiventris* Friese, 1904=*malvacearum* Cockerell, 1926; *caudens* Pérez, 1911; *dimidiata*

Herbst, 1917; *electa* (Cresson, 1878); *fulvicollis* Spinola, 1851; *junebris* Smith, 1879=*cana* Herbst, 1917 (male not seen); *gayi* Spinola, 1851; *hirsuta* Spinola, 1851; *lugubris* Smith, 1879; *mendocina* Joergensen, 1909 (male not seen); *mystica* Schrottky, 1902; *ocellata* new species; *piurensis* Cockerell, 1911; *quadrifasciata* Friese, 1898; *ruficollis* Friese, 1906; *vestita* (Smith, 1879); *weyrauchi* Moure, 1953; *yarrowi* (Cresson, 1875).

Species of this subgenus are numerous in temperate South America, especially Chile; in tropical South America they are probably restricted to arid regions and mountains; none are known from Central America but three species occur in the southern United States (north to Kansas) and northern Mexico.

Caupolicanooides new subgenus

(Figs. 6-9, 10, 48)

Type species: *Caupolicana pubescens* Smith, 1879 (= *C. herbsti* Friese, 1904).

The description is based on a male of this species, marked as a "typus" of *herbsti*, in the United States National Museum.

1. Inner orbits moderately converging above in male, ocellular distance equal to ocellar diameter. 2. Clypeus of male about 0.57 times as long as wide. 3. Scape of male over three times as long as wide. 4. Front basitarsus of male straight, distinctly shorter than remaining tarsal segments. 5. Hind tibia of male straight. 6. Basitibial plate of male complete. 7. Hind basitarsus of male less than four times as long as wide. 8. All femora of male with abundant long hair, base of middle femur of male with area of short erect hair ventrally. Front femur over three times as long as broad. 9. Stigma slightly broader subapically than basally, discal area distinctly broader than marginal thickenings; first submarginal cell distinctly shorter than second and third together; marginal cell broad (as well as unusually long), little over four times as long as wide; cell 1st M about 2.6 times as long as wide; first recurrent vein shorter than posterior margins of second and third submarginal cells which are subequal to first abscissa of Cu_1 (i.e., posterior margin of cell 2nd M). 10. Pubescence ochraceous, on metasomal terga erect and not forming bands, especially long on sterna of male. 11. Metasoma nonmetallic. 12. Terga of male without lateral areas of short erect hair. 13. Sixth sternum of male with long hairs, posterior margin slightly produced medially, the apex of the projection gently concave; surface hairy to apex. 14. Dorsal apical process of seventh sternum of male spatulate, ventral apical process large, broad, hairy above, slightly spatulate.

Caupolicanooides is known to me only from the type species which is from Chile.

The striking features of this subgenus are the large marginal cell and large stigma, presumably primitive features by which *C. pubescens* differs from all

other *Caupolicanini*. Characters 3 and 10 above are the only other features by which *Caupolicanoides* differs from all species of *Caupolicana s. str.*

However, in various other features *Caupolicanoides* falls at one extreme of the variation among the species of *Caupolicana s. str.* Character 6 is especially striking since basitibial plates are often of importance in classification of bees; *C. quadrifasciata* and *hirsuta* have such plates in the male, just as does *Caupolicanoides*. In other species known to me the plates are delimited only posteriorly. In characters 2, 4, 5, and 7 also, as well as in those parts of 9 not dealing with the stigma and marginal cell, *Caupolicanoides* is at one extreme of the variation within *Caupolicana s. str.* or just beyond that extreme; for example in character 4, the basitarsus is slightly shorter than in those species of *Caupolicana s. str.* in which it is shortest. As to character 14, the apical lobes of the seventh sternum are slightly broader, more spatulate, and more hairy than in *Caupolicana* proper, but are only a little different from those of *quadrifasciata* and *hirsuta* which are in turn closely approached by *ruficollis*. In these three species and also in *albiventris* the close connection between the lower apical lobes of this sternum and the bases of the upper ones is obvious, while in other species the lower lobes seem principally connected to the lateral margins of the sternum. The wing of *hirsuta* is illustrated (Fig. 12) to show how unlike *Caupolicanoides* it is in spite of certain other resemblances of that species to that subgenus.

Subgenus *Willinkapis* Moure (Figs. 11, 12)

Willinkapis Moure, 1953, Dusenja, 4:66; Moure, 1964, Studia Ent., (n.s.) 7:453.
Type species: *Ptiloglossa chalybea* Friese, 1906, by original designation.

1. Inner orbits moderately converging above in male, ocellocular distance slightly less than ocellar diameter. 2. Clypeus of male about 0.65 times as long as wide. 3. Scape of male less than three times as long as wide. 4. First basi-

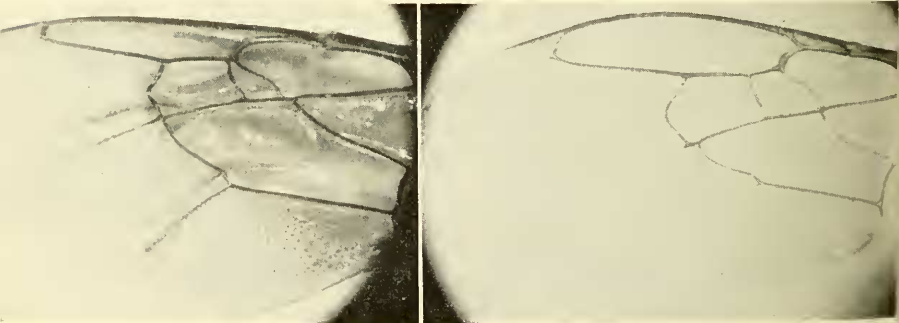


FIG. 10. Forewings of males. Left, *Crawfordapis luctuosa* (specimen from type series of *crawfordi* from Costa Rica). Right, *Caupolicana (Caupolicanoides) pubescens* (specimen from Concepción, Chile, labeled as "typus" of *herbsti* by Friese, USNM).

tarsus of male slightly arcuate, as long as remaining tarsal segments. 5. Hind tibia of male slightly arcuate. 6. Basitibial plate of male indicated only on posterior margin. 7. Hind basitarsus of male less than four times as long as wide. 8. All femora of male with abundant long hair, less long on middle femur than on others; base of middle femur of male with area of short, erect hair ventrally. Front femur over three times as long as broad. 9. Stigma narrower apically than basally, discal area narrower than marginal thickenings; first submarginal cell equal to second and third together (first on posterior margin shorter than second and third); marginal cell narrow, nearly six times as long as wide; cell 1st M about three times as long as wide; first recurrent vein about equal in length to posterior margins of second and third submarginal cells together which are shorter than first abscissa of Cu_1 (i.e., posterior margin of cell 2nd M). 10. Pubescence, at least that of metasoma, largely black, terga with narrow marginal bands of dense hair which is sometimes white; sterna two to five of male with very long hair. 11. Metasoma strongly metallic blue (more metallic than in most *Ptiloglossa*). 12. Terga of male without lateral areas of short erect hair. 13. Sixth sternum of male with hairs short and sparse, posterior margin medially produced, the projection emarginate much as in *Zikanapis* and *Crawfordapis* but projection narrower and shorter; surface with hairs nearly to apex. 14. Dorsal apical process of seventh sternum of male very slender, not at all spatulate; ventral apical process probably represented by a broad, apically rounded, laterally directed, heavily sclerotized, lateral apical projection which is hairless except mesally.

In characters 11 and 14, *Willinkapis* is unique among the subdivisions of *Caupolicana*. Its other features are all more or less duplicated among one or another of the subgenera, although the combination is not found elsewhere.

Willinkapis, which has hitherto been accorded generic rank or placed as a subgenus of *Zikanapis*, is known to me from two species. One is *C. (Willinkapis) chalybea* (Friese) known from the cordilleran region of Argentina (see Moure, 1953). It ranges northward into Peru as shown by a female in the United States National Museum from Huanta, Andes, Peru, 2400 meters, March 24, 1941 (F. W. Woytkowski). From the same locality is a female of another, slightly smaller, species with the pubescence nearly all black.

Subgenus *Zikanapis* Moure

(Figs. 12, 30-34, 47)

Zikanapis Moure, 1945, Arq. Mus. Paranaense, 4:147; Moure, 1964, Studia Ent., (n.s.) 7:421.

Type species: *Ptiloglossa zikani* Friese, 1925, by original designation.

Foersterapis Moure, 1964, Studia Ent., 7:441 (new synonym).

Type species: *Zikanapis foersteri* Moure and Seabra, 1962, by original designation.

1. Inner orbits moderately to strongly converging above in male, ocellular distance one third to one half an ocellar diameter. 2. Clypeus of male about 0.85 times as long as wide. 3. Scape of male over three to nearly four times as

long as wide. 4. First basitarsus of male not or scarcely arcuate, distinctly shorter than remaining tarsal segments. 5. Hind tibia of male slightly arcuate. 6. Basitibial plate of male indicated only on posterior margin. 7. Hind basitarsus of male four or five times as long as broad. 8. Front femur of male with abundant long hair beneath, other femora with shorter hair; middle femur of male without area of short erect hair. Front femur three or more times as long as broad. 9. As in *Willinkapis*. 10. Pubescence largely ochraceous or in some South American forms extensively dark, forming apical white bands on metasomal terga of some species. 11. Metasoma nonmetallic. 12. Lateral extremities of terga 2 to 4 and sometimes 5 and 6 of male with large areas densely covered by short erect hair of uniform length, these areas under low magnification appearing dull and scarcely punctate in contrast to adjacent areas. 13. Sixth sternum of male with hairs short, posterior margin medially produced and rather broadly bilobed; surface with hairs nearly to apex. 14. Dorsal apical process of seventh sternum of male spatulate, ventral apical process small and projecting but little from sternal margin.

Characters 1, 2, and 12 are suggestive of *Ptiloglossa*, and Moure (1945) quite properly compared *Zikanapis* with *Ptiloglossa* as well as with *Caupolicana*. However, the majority of the characters indicate placement in *Caupolicana*. One of the characters on which Moure placed special emphasis, the convergence of the eyes in *Zikanapis*, is weak because they are only moderately convergent in *C. (Z.) elegans* and in some of the other forms which he included in *Zikanapis* in 1964.

Zikanapis, which has hitherto been accorded generic rank, contains several species and seems most common in the northern and southern subtropical regions, much less so in the intervening tropics although *modesta* is from Colombia. Included species are: *clypeata* (Smith, 1879); *elegans* Timberlake, 1965; *foersteri* (Moure and Seabra, 1962); *funeraria* (Moure, 1964); *megaopta* (Moure, 1948); *modesta* (Moure, 1964); *seabrai* (Moure, 1953); *tucumana* (Moure, 1945); and *zikani* (Friese, 1925).

The two species, *foersteri* and *tucumana*, which Moure (1964) placed in a subgenus, *Foersterapis*, of *Zikanapis* seem to me too similar to other *Zikanapis* to warrant separation although they do constitute a distinctive group. At the present stage of the development of systematics, there is no objective basis for such decisions and I can only say that I see no obvious advantage in separating *Foersterapis* as a named group.

Alayoapis new subgenus

(Figs. 12, 37-42, 48)

Type species: *Megacilissa nigrescens* Cresson, 1869.

1. Inner orbits strongly converging above in male, ocellocular distance less than one fourth of an ocellar diameter. Posterior margins of posterior ocelli of

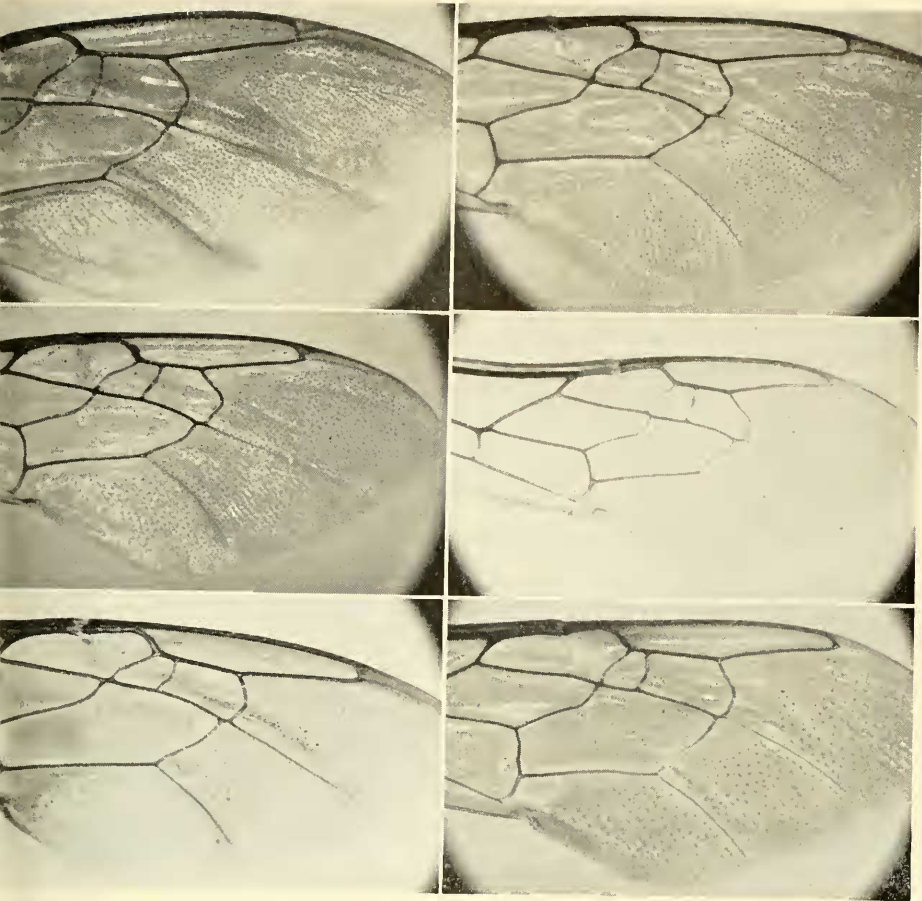


FIG. 12. Forewings. Above left, *Caupolicana* (*Willinkapis*) *chalybaea*. Above right, *C.* (*Caupolicana*) *yarroui*. Center left, *C.* (*C.*) *hirsuta*. Center right, *C.* (*C.*) *ocellata*. Below left, *C.* (*Alayoapis*) *nigrescens*. Below right, *C.* (*Zikanapis*) *clypeata*.

male well in front of narrowest part of vertex (unlike other subgenera but like *Crawfordapis*). 2. Clypeus of male about or nearly 0.7 times as long as wide. 3. Scape of male about three times as long as wide. 4. First basitarsus of male slightly arcuate, slightly longer than remaining tarsal segments. 5. Hind tibia of male slightly arcuate. 6. As in *Willinkapis* or no indication of basitibial plate in *notabilis*. 7. Hind basitarsus of male nearly five to over five times as long as wide. 8. Hair of femora of male short, not longer than femoral diameter, that of middle femur much shorter except in *notabilis*; base of middle femur of male without area of short erect hair ventrally. Anterior femora thick, not over three times as long as wide. 9. As in *Willinkapis*, but first submarginal cell longer than second and third together (first on posterior margin

equal to second and third). 10. Body with considerable dark pubescence, that of metasoma short; terga in some species with apical white fasciae; sterna 2-4 of male with rather long hair. 11. Metasoma nonmetallic. 12. As in *Wil-linkapis*. 13. Sixth sternum of male with median nearly hairless area or in *notabilis* with short erect hairs; hairs of margin rather dense; posterior margin rounded, with hairs nearly to apex but margin proper a thin hairless translucent flange (doubtful in *notabilis*). 14. Dorsal apical process of seventh sternum of male slightly spatulate with median lobe suggestive of *Ptiloglossa* but shorter; ventral apical process absent.

The combination of characters 1 and 13 (rounded margin of sixth sternum) is not found elsewhere in the genus.

Alayoapis, named after Dr. Pastor Alayo D. of La Habana, Cuba, who has collected more specimens of the subgenus than anyone else and has provided me with useful information about the subgenus. It is known only from the islands of Cuba and Hispaniola.

D. NORTH AMERICAN SPECIES OF THE GENERA *CRAWFORDAPIS* AND *CAUPOLICANA*

This section concerns the species found not only in North America proper but also in Central America and in the Antilles. Probably all of the species are active principally in early morning and late evening, some of them when it seems completely dark to human observers. Nests are made in deep burrows, often and perhaps always in sandy soil. Known details of behavioral matters are indicated under each species.

In the synonymies only major references are given, not mere records or repetitive generic changes.

KEY TO THE SPECIES

1. Metasomal integument red. *Caupolicana (Alayoapis) notabilis*
- Metasomal integument dark brown or black. 2
2. Legs largely light red or yellowish. 3
- Legs or at least hind leg reddish brown to black, usually more or less the same color as the body. 5
3. Antenna yellowish red; ocellar diameter nearly twice maximum width of scape. *Caupolicana (Caupolicana) ocellata*
- Antenna largely dark brown or black; ocellar diameter little if any greater than maximum width of scape. 4
4. Middle femur of male contorted; head and thorax with some black or dusky and dark tipped hairs. *Caupolicana (Alayoapis) subaurata*
- Middle femur of male not contorted; head and thorax with hair entirely ochraceous. *Caupolicana (Caupolicana) electa*
5. Male with lateral extremities of terga 2-4 with large areas of short, dense

- hair of uniform length, producing a distinctive dull appearance; clypeus of female rather flat with uniform punctation and short hairs over entire surface. 6
- Male with lateral extremities of terga without such specialized areas; clypeus of female more convex with much variation in density of punctation and of hairs. 7
6. Male without metasomal bands; interocellar distance of female slightly more than maximum ocellar diameter. *Caupolicana (Zikanapis) clypeata*
- Male with bands of white hair at least laterally on apices of terga 2-5; interocellar distance of female over twice maximum ocellar diameter. *Caupolicana (Zikanapis) elegans*
7. Metasomal terga without bands of pale hair. *Crawfordapis luctuosa*
- Metasomal terga with apical bands of white hair. 8
8. Hairs of thorax ochraceous, many of them dark tipped in female. *Caupolicana (Caupolicana) yarrowi*
- Hairs of thorax with large areas of black to dark gray. *Caupolicana (Alayoapis) nigrescens*

DI. SPECIES OF CRAWFORDAPIS

There is only one recognized species of this genus.

Crawfordapis luctuosa (Smith)

(Figs. 1-5, 10, 11)

Megacilissa luctuosa Smith, 1861, Jour. Entom., 1:150.

Ptiloglossa crawfordi Cockerell, 1919, Proc. U.S. Nat. Mus., 55:178.

Zikanapis (Crawfordapis) luctuosa: Moure, 1964, Studia Entom., (n.s.) 7:449.

Crawfordapis luctuosa is a dusky haired species with light orange hairs at the apex and on the under surface of the metasoma. The femoral and propodeal scopa of the female is largely cream colored. The species was described from Mexico, without other data. The type is in the British Museum (Natural History). The name *crawfordi* was based on material from "Ujurass de Teraba," Costa Rica and the type is in the U.S. National Museum. A series of males in the British Museum (Natural History) is from Cerro Zunil, 4000-5000 feet altitude (Champion). According to Selander and Vaurie (1962) this locality is Volcán Zunil, Quezaltenago, Guatemala.

These Guatemalan males differ from Costa Rican material in being slightly larger with light hair mixed with the black all over the face below the antennae, with a band of light hair across the front of the scutum, with light hair on the posterior surface of the propodeum, the anterior surface of the first metasomal tergum, and the sides of the metasoma anteriorly, and with the whole venter of the metasoma covered with orange hair. Possibly they represent a distinct species or geographical variant. My drawings of genitalia and sterna are based on a specimen in the type series of *crawfordi*



FIG. 11. Faces, males at left, females at right. Above, *Crawfordapis luctuosa*; below, *Caupolicana* (*Willinkapis*) *chalybaea*.

from Costa Rica. Moure (1964) reports specimens from Volcán Tacanas, Chiapas, Mexico; the Departamento de Chimaltenango, Guatemala; and Los Planes, El Salvador. Presumably his drawings are based on a specimen from one of these more northern localities and the differences between his drawings and mine may support the idea that different forms are involved.

D2. NORTH AMERICAN SPECIES OF THE SUBGENUS CAUPOLICANA

There are three species of this subgenus in North America, each very different from the others and equally different from the South American

species of the subgenus. *C. yarrowi* and *electa*, however, are more similar to one another than either is to *ocellata* or any other species, and *ocellata* is a very isolated form.

Caupolicana (Caupolicana) yarrowi (Cresson)

(Figs. 12, 13-17, 29)

Megacilissa yarrowi Cresson, 1875, Rep. U.S. geogr. survey west of one hundredth meridian, 5:723.

Male: Length 17-21 mm; wing length 14-16½ mm.

1. Inner orbits converging above. Eyes closest on a line that is tangent to posterior margins of posterior ocelli, the latter far in front of posterior margins of eyes; ocellar diameters about equal to maximum width of scape; ocellocular distance more than half of width of ocellus. 2. Basal part of labrum with two distinct longitudinal ridges submedially and weak longitudinal wrinkles laterally. 3. First flagellar segment longer than scape. 4. Anterior femur much thickened, especially broad basally where expanded posteriorly so that it is less than three times as long as broad; middle and hind femora progressively more slender. 5. Anterior femur with rather dense long hairs on lower surface, especially dense near posterobasal angle; other femora with only short sparse hairs ventrally except for small (one fifth as long as femur) basal patch of rufescent hairs on middle femur. 6. Hind basitarsus with apical third distinctly wider than basal third, the basitarsus little over half as long as the slender and distinctly curved tibia. 7. Propodeal triangle without transverse ridges. 8. Posterior margins of sternum 2 and usually 3-4 broadly emarginate. 9. Apex of sternum 6 rounded. 10. Hidden sterna and genitalia as shown in Figures 13 to 17. 11. Integument black, legs brownish black, under side of flagellum brown, tegula yellow brown. Wings light brownish with dark brown veins and stigma. 12. Pubescence of head white, ochraceous on vertex; pubescence of thorax, legs, and first tergum ochreous, paler on venter and on coxae, trochanters, and femora; dorsum of metasomal terga 2 to 7 with hair black, apical white bands on terga 2 to 4, these bands widest laterally and narrowed medially; metasomal sterna 1-4 with white hair, remaining sterna with dusky hair (see comments below on variation).

Female: Length 18-20 mm; wing length 19 mm.

13. Inner orbits subparallel except upper parts. 14. Ocellar diameters about equal to maximum width of scape; ocellocular distance greater than ocellar diameter. 15. First flagellar segment longer than scape, third broader than long and distinctly shorter than following segments. 16. Basal part of clypeus distinctly more shining than supraclypeal area, with distinct punctures. 17. Anterior coxa with apical spine covered with ochreous hair. 18. Propodeal triangle as in male (character 7). 19. Integument colored as in male (character 11). 20. Pubescence of head white with scattered dusky hairs intermixed except on genal area; hair of vertex wholly dusky or black; subapical fringe of

clypeus and lower fringe of mandible rufescent. Hairs of thorax and first tergum ochraceous, whiter laterally, those of dorsum and pronotal tubercles and upper part of mesepisternum dark tipped. Hairs of basal segments of legs whitish or ochraceous except for areas of short reddish dusky hair on lower side of middle trochanter and base of middle femur; hairs of tibiae and tarsi dusky ochreous to almost black except that scopula of under side of hind tibia, like that of femur and trochanter, is white. Dorsum of metasomal terga 2-6 with black hair except for white apical bands, slightly narrowed medially, on 2-4, also on 1. First two sterna with ochraceous hair; sterna 3-4 with similar hair on posterior margins but otherwise with reddish dusky to blackish hair; sterna 5-6 with hair reddish dusky to black.

This species is closest to *C. electa* as is shown by characters 1, 2, 3, 4, 9, 14, 15, and 16 as well as by sternal and genital characters of the male, especially the ventroapical lobes of the seventh sternum. The other characters, as well as some aspects of those listed above, separate *yarrowi* from *electa*.

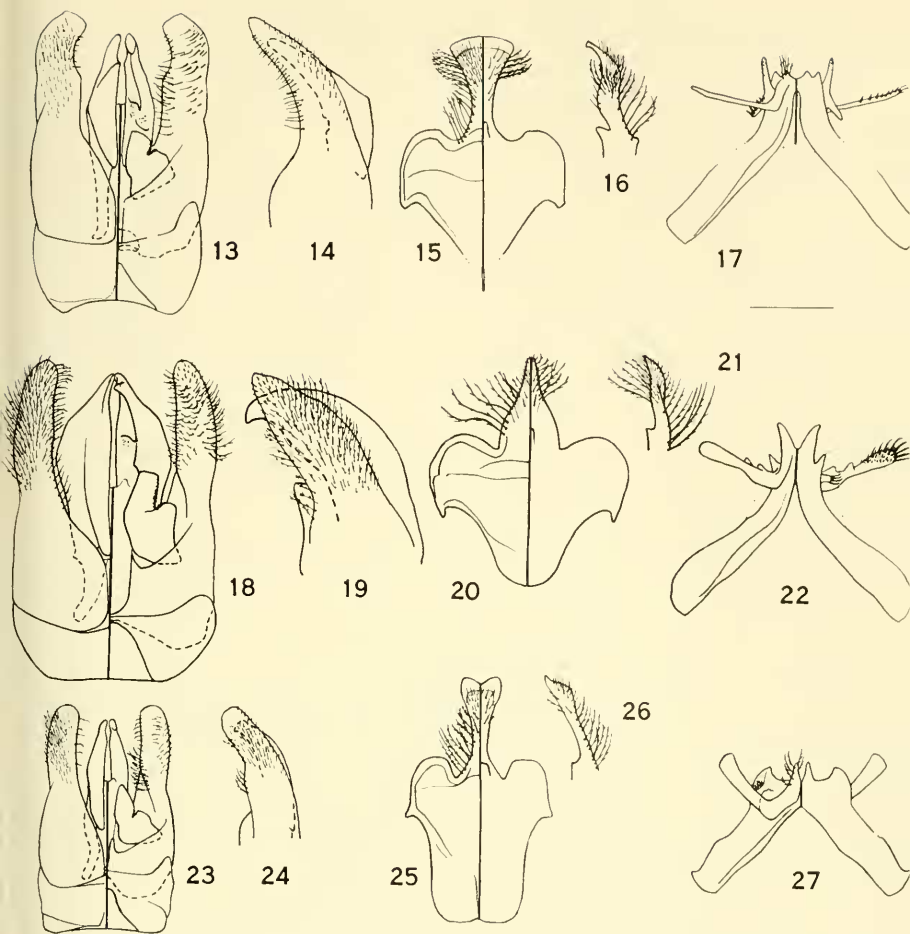
C. yarrowi was described from New Mexico and the type is in the Academy of Natural Sciences of Philadelphia (no. 2141). It occupies a wide range in the desert and semidesert areas of the southwestern United States and Mexico (see Figure 28). Records for Florida (Fox, 1898; Graenicher, 1930) are errors based on specimens of the broad banded southern form of *C. electa*.

Altitude ranges from 4000 feet at Douglas, Arizona, to 5300 feet at La-Cueva in the Organ Mountains, New Mexico, and to 6400 feet at El Tascate, Durango, and Zimapán, Hidalgo.

Specimens have been collected as early as June 6 (Huachuca Mountains, Arizona) and June 23 (Tehuacán, Puebla) but most records are in July and August, with one record on September 5 (Organ Mountains, New Mexico).

There is available a single male of a probably distinctive population or species from the southern extremity of the range. The specimen, from the state of Puebla (Tehuacán, June 23, 1951, H. E. Evans), is unusually large with the white metasomal bands reduced; sterna 2-4 (especially 2) are unusually broadly and deeply emarginate; the pubescence of the fourth and part of that of the third sterna is blackish like that of the following sterna instead of pale like that of the preceding sterna; the femora are unusually robust, the anterior one greatly produced posteriorly at the base and not much over twice as long as wide; and the middle basitarsus is broadest medially instead of parallel sided and of uniform width.

Cockerell (1899) records the flight of *C. yarrowi* as from 5:15 to 6:15 a.m. (between dawn and sunrise) on September 4 and 5 in the Organ Mountains, New Mexico. He records a series from flowers of *Datura meteloides*, and two from *Lippia wrightii*. Probably these were nectar sources and Linsley (1960) and Linsley and Hurd (1959) record males of *C. yarrowi* taking nectar from *Melilotus alba* and *Larrea divericata*. At least on the latter plant the bees were



FIGS. 13-17, *Caupolicana (Caupolicana) yarrowi*; 18-22, *C. (C.) electa*; 23-27, *C. (C.) ocellata*; males. For each species structures are genitalia; lateral view of apical part of genitalia, eighth sternum, lateral view of apical process of same, and seventh sternum. For further explanation see Figures 6-9. The scale line represents 1 mm for all three species.

active before dawn. I have also seen the species near Douglas, Arizona, at about sunrise on *Larrea*, not collecting pollen. Specimens collected at Encarnación de Diaz, Jalisco, on *Eysenhardtia polystachya*, had no pollen on the scopa and probably were feeding on nectar.

Linsley and Cazier (1963) treat the pollen collecting, especially on *Solanum*, in some detail, showing, for example, that in mid-August in southern Arizona on a clear morning the activity was from 5:20 to 6:50 while on an overcast morning it was from 5:20 to 8:50 (sunrise both days was at approximately 6:00). Most other pollen collecting bees on the same flowers started

later and continued much later, but *Ptiloglossa jonesi* Timberlake, while largely synchronous with *C. yarrowi*, started work perhaps slightly earlier and under overcast conditions stopped its activities considerably earlier than *C. yarrowi*. Pollen collecting, however, is not restricted to *Solanum* and 70% of the females collecting on *Solanum* already carried some *Mentzelia*-like pollen. At the same place where it visits *Solanum* in the morning, *C. yarrowi* collects pollen in the evening (17:50-19:13; sunset at 18:51) from *Mentzelia pumila*, a flower that is not open in the morning. Linsley and Cazier (1963) also give a brief account of the scopal structure.

Linsley (1962) records males of *C. yarrowi* sleeping while grasping *Melilotus* stems with their mandibles, but he observed no aggregations of such bees.

Caupolicana (Caupolicana) electa (Cresson)

(Figs. 18-22, 29)

Megacilissa electa Cresson, 1878, Proc. Acad. Nat. Sci. Philadelphia, p. 221.

Caupolicana electa; Mitchell, 1960, Bees of the Eastern United States, 1:23.

Megacilissa yarrowi; Fox, 1898, Ent. News, 9:128 (misidentification).

Caupolicana (Megacilissa) yarrowi; Graenicher, 1930, Ann. Ent. Soc. Ame., 23:161 (misidentification).

Male: Length 18-20 mm; wing length 15-15½ mm.

1. As in *yarrowi*. 2. Labrum with longitudinal ridges reduced to two gentle submedian convexities; wrinkles absent. 3. As in *yarrowi*. 4. Anterior femur thickened, less than four times as long as broad, not expanded basoposteriorly but thickest shortly before middle; middle and hind femora about equal in thickness, not enlarged. 5. Anterior femur with rather dense long hairs on lower surface; other femora with hairs shorter and sparser ventrally but less short and sparse than in *yarrowi*, basal patch of dense rufescent hairs on middle femur extending beyond middle. 6. Hind basitarsus parallel sided, scarcely over half as long as the slender and distinctly curved tibia. 7. Propodeal triangle with a few transverse ridges, sometimes weak. 8. Posterior margins of sterna 2-4 transverse. 9. As in *yarrowi*. 10. Hidden sterna and genitalia as shown in Figures 18 to 22. 11. Integument black, tegula and legs yellowish brown, infuscated on coxae, trochanters, and femora; under side of flagellum dark brown, lightest apically. Wings colored as in *yarrowi*. 12. Pubescence of head, thorax, legs, first tergum, lateroventral extremities of second tergum, and first two sterna ochreous, most deeply colored on dorsum of thorax; rest of metasoma with pubescence fuscous or black, very narrow apical bands of white pubescence on terga 2-4, sometimes reduced to lateral parts of 2 and absent on 3 and 4; or in specimens from southern Florida, these bands as in *yarrowi*.

Female: Length 17-18 mm; wing length 19 mm.

13. Inner orbits slightly converging below except upper parts which converge above. 14. As in *yarrowi*. 15. First flagellar segment longer than scape,

third slightly longer than broad. 16. As in *yarrowi*. 17. Anterior coxa without spine. 18. Propodeal triangle as in male (character 7). 19. Integument colored as in male (character 11) but legs reddish brown rather than yellowish brown. 20. Pubescence as in male (character 12) but that of tarsi and outer surfaces of tibiae deep ochreous, that of area of basitibial plate brown, that of sterna 2-3 reddish dusky, lateral extremities of sterna 2-4 with long ochraceous hair. The one female studied from the main range of the species has the apical tergal bands present; in southern Florida they are broad as in the male from that area.

This species is most similar to *C. yarrowi*. The similarities and differences are summarized under that species.

Caupolicana electa was described from Georgia and the type (no. 2140) is in the Academy of Natural Sciences of Philadelphia. It is known from sandy areas in the eastern lowlands from North Carolina to Georgia, Alabama, and northwestern Florida (Fig. 28). Localities are Mobile, Alabama; Crestview, Okaloosa County, Florida; Southern Pines and Lakeview, Moore County, North Carolina; and Harnett County, North Carolina. In addition, at least two specimens have also been collected in Dade County, southern Florida (Fox, 1898; Graenicher, 1930).

The specimens from southern Florida have broad white tergal bands and look superficially like *C. yarrowi*, which accounts for their misidentification by Fox and Graenicher. They are also smaller and more slender than typical *electa*. In other features, however, they agree with *electa*. The probable speci-

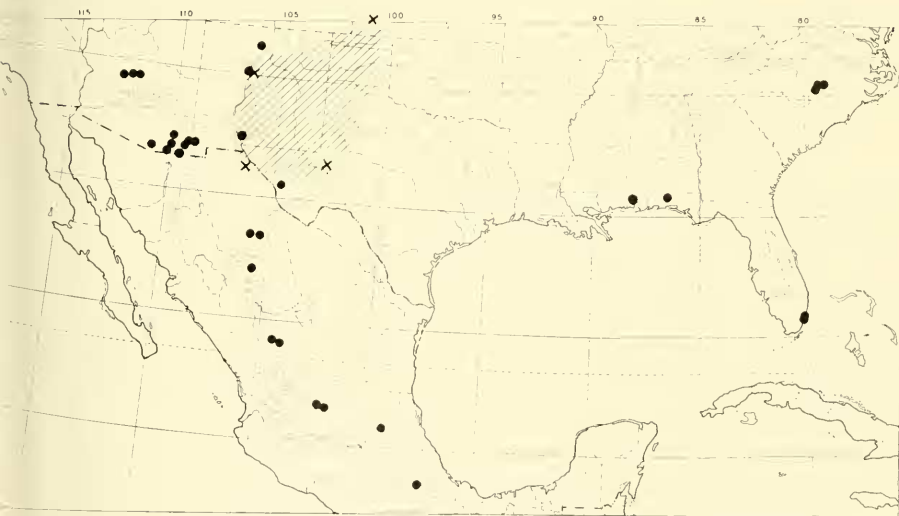


FIG. 28. Map showing distribution of the North American species of *Caupolicana* s. str. Dots in Mexico and the west show records of *C. yarrowi*; dots in the east, *C. electa*; crosses held together by shading, *C. ocellata*.

men (a male) which Fox recorded merely from Florida is in the American Museum of Natural History, labeled as from Biscayne Bay. The specimen taken by Graenicher was from South Miami.

The season of flight seems to be autumnal (September and October). Flower records on specimens seen are yellow *Gerardia* (= *Aureolaria*) and *Trichostemma*. The flight period is reported as "around sunrise" and late afternoon or dusk (Mitchell, 1960; Graenicher, 1930).

Caupolicana (Caupolicana) ocellata new species
(Figs. 12, 23-27, 29)

Male: Length 14-15 mm; wing length 11½-12 mm.

1. Inner orbits parallel except for upper parts which converge. Eyes closest on a line that passes through posterior ocelli, the latter extending back almost as far as posterior margins of eyes; ocelli enormous, diameters much greater than maximum width of scape, ocellocular distance less than half width of ocellus. 2. As described for *yarrowi* but ridges weaker and wrinkles fewer and coarser. 3. First flagellar segment about as long as scape. 4. Femora of about equal thickness, anterior one about four times as long as broad. 5. Anterior femur with rather dense long hair on lower surface, middle and hind femora with ventral vestiture progressively sparser and shorter; patch of rufescent hair at base of middle femur absent. 6. Hind basitarsus parallel sided, distinctly over half as long as tibia. 7. Propodeal triangle as in *yarrowi*. 8. As in *electa*. 9. Apex of sternum 6 with median broadly V-shaped emargination. 10. Hidden sterna and genitalia as shown in Figures 23 to 27. 11. Integument black; labrum, basal half of mandible, antenna, tegula and legs yellow brown or testaceous; coxae, trochanters, and femora darker brown. Wings nearly clear, veins and stigma brown. 12. Pubescence white, slightly ochraceous on dorsum of thorax and on terga 6-7; dorsal surfaces of terga 2-5 with hair black or fuscous except for broad apical white bands, not narrowed medially, on terga 1-5.

Female: Length 15-16 mm; wing length 11-12 mm.

13. As in *electa*. 14. Ocellar diameter much greater than maximum width of scape; ocellocular distance over half ocellar diameter. 15. First flagellar segment shorter than scape, third as broad as long or longer than broad. 16. Basal part of clypeus dull and granular like supra-clypeal area. 17. As in *yarrowi*. 18. Propodeal triangle as in male (character 11). 19. Integument as in male (character 11), but pale areas, including lower part of clypeus, reddish brown rather than yellow brown. 20. Pubescence white, slightly ochraceous on dorsum of thorax, on outer surfaces of tibiae and tarsi, on under surface of middle trochanter and base of femur, and on terga 5-6; dorsal surfaces of terga 2-4 with hair dusky except for broad apical white bands on terga 2-4, a narrower one on 1; metasomal sterna with hair ochreous.

Caupolicana ocellata is one of the most strikingly distinct species of *Caupolicana*. Characters 1, 3, 4, 5, 9, 14, and 15, are especially distinctive.

I am pleased to accept the specific name suggested by Padre J. S. Moure when he saw this remarkable species; the name is given in reference to the enormous ocelli.

The species occurs in sandy areas in the southern high plains and adjacent semidesert areas from Kansas to Chihuahua (Fig. 28). Type material is as follows:

Holotype female and five female paratypes: Three miles south of Garden City, Finney County, Kansas, September 3, 1951 (C. D. Michener and W. E. LaBerge). One female paratype, same data but 5 miles south of Garden City. Three female paratypes, type locality (labeled Garden City), August 29, 1952 (W. E. LaBerge). Allotype male and one male paratype: Albuquerque, New Mexico, July 23, 1950 (R. H. Beamer, H. O. Wright). The above are all from the Snow Entomological Museum of The University of Kansas. One female paratype: Samalayuca, Chihuahua, June 24, 1947 (D. Rockefeller Expedition, C. D. Michener), in the American Museum of Natural History. Forty-seven male and 11 female paratypes: 6.7 miles south of Manahans, Ward County, Texas, June 1-2, 1964 (Peter H. Raven) in the collection of the California Insect Survey, University of California, Berkeley.

A paratype taken with the holotype in Kansas is in the collection of Padre J. S. Moure, Curitiba, Brazil; another is in that of Dr. C. A. C. Seabra, Rio de Janeiro.

Females have been recorded only on *Dalea lanata*; those from both Kansas and Texas were on this flower. Males have been taken on another small legume, *Petalostemum flavescens* (in New Mexico) and on an onagraceous flower, *Gaura coccinea* (in Texas).

Specimens from Kansas were taken from early to mid morning and a female was seen to enter her nest after 9:00 a.m. on a sunny day.

In Texas observations are available on the times of day when specimens were collected on June 2, 1964, at flowers of *Dalea lanata*, thanks to Dr. Peter H. Raven of Stanford University. The specimens were collected and thus removed from the population; figures for later in the day might have been higher had this not been the case. However, Table 1 clearly shows that *C. ocellata* was active early in the morning and late in the evening and that the other principal visitors to the same flowers, *Martinapis luteicornis* (Cockerell) and *Agapostemon texana* Cresson, appeared later and disappeared earlier, having little overlap with the *Caupolicana*. Dr. Raven arrived at the site at 5:00, when it was barely light, and found the *Caupolicana* common; they were much rarer by 5:45. He writes that at 20:10 they became abundant again and continued until 20:40 when it was pitch dark and he had to use a flash light to see the bees. After that time the bees were scarce or absent.

TABLE I. Times of Capture of Principal Visitors to Flowers of *Dalea lanata* at Manahans, Ward Co., Texas, on June 2, 1964, by Dr. Peter H. Raven. Sunrise was about 5:40; sunset at 19:46.

	Caupolicana ocellata		Martinapis luteicornis		Agapostemon texanus		°F
	♂ ♂	♀ ♀	♂ ♂	♀ ♀	♂ ♂	♀ ♀	
5:30-6:00	22	1	....	....	....	....	58
6:00-7:00	5	3	....	....	....	....
No observations made							63
7:30-8:00	2	....	5	2	4	1	65
8:00-8:30	1	....	20	3	6	2	68
Discontinuous observations	....	....	....	....	active all day		to 95
18:30-19:00	6	....	7	1	7	1	89
19:00-19:15 .....	....	....	6	1	4	....	88
No observations made							
19:45-20:00 .....	....	4	....	....	....	....
20:00-20:30	2	....	....	....	....	....	83

Of the eight males taken on *Gaura coccinea*, four were collected from 7:30 to 8:15, four from 15:45 to 20:30.

Nests were found by me in loose sand of dunes stabilized by vegetation, three miles south of Garden City, Kansas. They entered horizontal surfaces among small plants in the vicinity of the flowering *Dalea lanata*. I dug two nests. One seemed to consist of only a burrow although the bees were badly tattered and no males were taken, suggesting that the season was well advanced (September 3). The other was 60 cm deep, vertical, rather straight. At the bottom it turned sharply to one side, extended laterally for 8 cm to a vertical cell lined with a membrane similar to that of other colletid cells and partially filled with liquid provisions. Another provisioned cell was found about 8 cm in another direction from the bottom of the vertical burrow; the horizontal burrow leading to it had been completely filled with sand. These very scanty data suggest basic nest structure reasonably similar to that of other *Caupolicana* species whose nests have been described.

D3. NORTH AMERICAN SPECIES OF *ZIKANAPIS*

The North American *Zikanapis* are similar to the South American *C. (Z.) megalopta* (Moure), being large bees with largely ochraceous pubescence. They are quite different from the type species, *C. (Z.) zikani* (Friese), which has much black pubescence. The North American species agree in the tufts of long hairs, sigmoidly curved, arising from the lateral extremities of the fifth sternum of the male, and less conspicuously from the fourth. They also agree in the rather flat clypeus of the female (flatter in *elegans*) with abundant, rather uniform punctation, finely roughened and dull surface between punc-

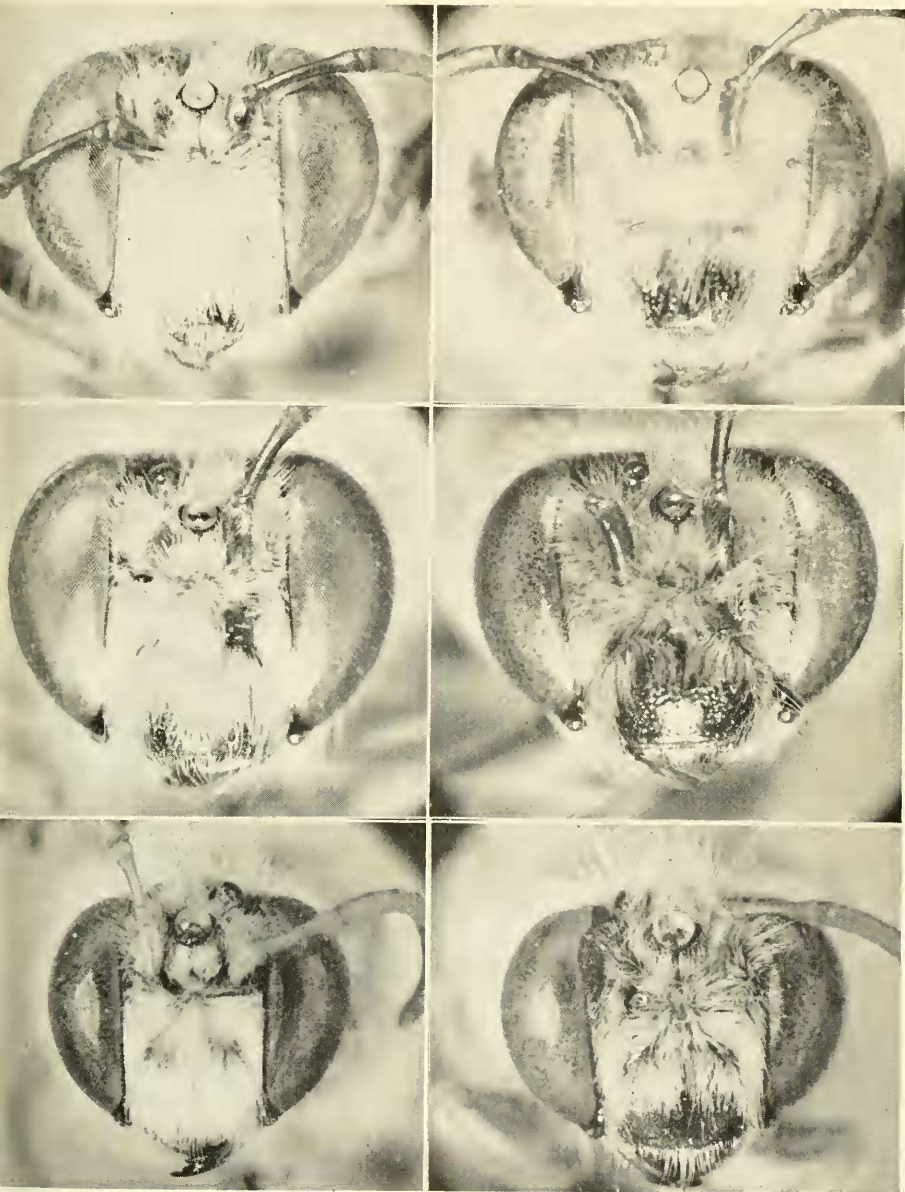


FIG. 29. Faces of North American species of *Caupolicana s. str.*, males at left, females at right. Above, *C. yarrowi*; center, *C. electa*; below *C. ocellata*.

tures, and abundant erect hairs or bristles, less than half as long as the longest hairs of the face, with apices commonly bent rather sharply downward.

The genitalia and hidden sterna of the two North American species are

similar. They are illustrated for *clypeata*; those of *elegans* have been studied only in a dry state and differ from those of *clypeata* as follows: penis valves and gonoforceps somewhat less broad apically, the former with the preapical angle (basal to slender, downward directed apex) more rounded; apical process of eighth sternum not quite so broad medially, the apical part parallel sided.

Caupolicana (Zikanapis) clypeata (Smith)

(Figs. 12, 30-34, 47)

Megacilissa clypeata Smith, 1879, Descriptions of new species of Hymenoptera in the collection of the British Museum, p. 59.

Caupolicana clypeata; Cockerell, 1905, Trans. Amer. Ent. Soc., 31:343.

Zikanapis (Zikanapis) clypeata; Moure, 1964, Studia Ent., (n.s.) 7:439.

Male: Length 15-17 mm; wing length 12½-13 mm.

1. Eyes strongly converging above, upper interocular distance about as long as scape; interocellar distance about equal to maximum ocellar diameter; ocellocular distance clearly less than half an ocellar diameter. 2. Penis valves widest subapically. 3. Integument black, under side of flagellum, clypeus, tegula, anterior and middle legs, and hind tarsi variably light brown, sometimes considerably infuscated; posterior margins of metasomal segments broadly transparent brownish. 4. Pubescence ochraceous, sometimes slightly dusky on vertex; shorter hairs of dorsum of metasoma, especially on second and third terga, slightly dusky; no pale fasciae on metasoma; hairs of outer surface of middle tibia slightly dusky, those of outer surfaces of hind tibia and basitarsus dusky or blackish.

Female: Length 16-18 mm; wing length 11½-12 mm.

5. Interocellar distance slightly more than maximum ocellar diameter. 6. Integument black, under side of flagellum especially apically and tegula light brown; fore and middle legs with considerable brownish color. 7. Pubescence of head largely whitish except that of clypeus which is brown; fuscous hairs intermixed with white on rest of face and genal areas; hair of vertex fuscous. Hair of dorsum of thorax ochraceous with dusky tips; hair of sides and venter whitish, apices dusky on upper parts of sides. First metasomal tergum and first two sterna with hair pale ochraceous or whitish, remaining sterna with hair ochraceous and somewhat infuscated except for very long, plumose, pale ochraceous hairs laterally on sterna 3 and 4; second to fourth terga with hair except at extreme sides blackish, and with apical bands of appressed white hair, narrowed medially; fifth and sixth terga with strongly infuscated, deep ochre hairs. Hairs of legs ochraceous, those of outer sides of tibiae and tarsi infuscated (slightly so on foreleg), hind tibial hairs of basitibial region and extending to middle of tibia black, scopa including hairs of inner sides of hind tibiae white.

This species was described from Oaxaca, Mexico. It is not clear whether this means the city or elsewhere in the state. I have examined the type in the British Museum (Natural History).

A series was collected on a misty morning in complete darkness at Tuxpan, Michoacán, September 1, 1962, by D. H. Janzen. The vicinity consists of cultivated land. Seven males were taken at car lights between 5:10 and 5:20 a.m., two males between 5:20 and 5:35 a.m., two males between 5:35 and 5:45 a.m. One male was taken on flowers of *Salvia* at the side of the road at first light (still much too dark to see the bee) at 5:45 a.m., another at 6:00 a.m. Two females were taken at the car lights, both at 5:50 a.m.

A single female was taken, with no details as to collecting time, 2 miles east of Lake Patzcuaro, Michoacán, July 25, 1954 (J. W. MacSwain).

Moure (1964) records specimens from Amula (now Almolonga, 9.5 km northwest of Chilapa), Guerrero, at 6000 feet altitude and 11 miles southwest of Acambaro, Guanajuato, August 17, 1954.

Caupolicana (*Zikanapis*) *elegans* Timberlake

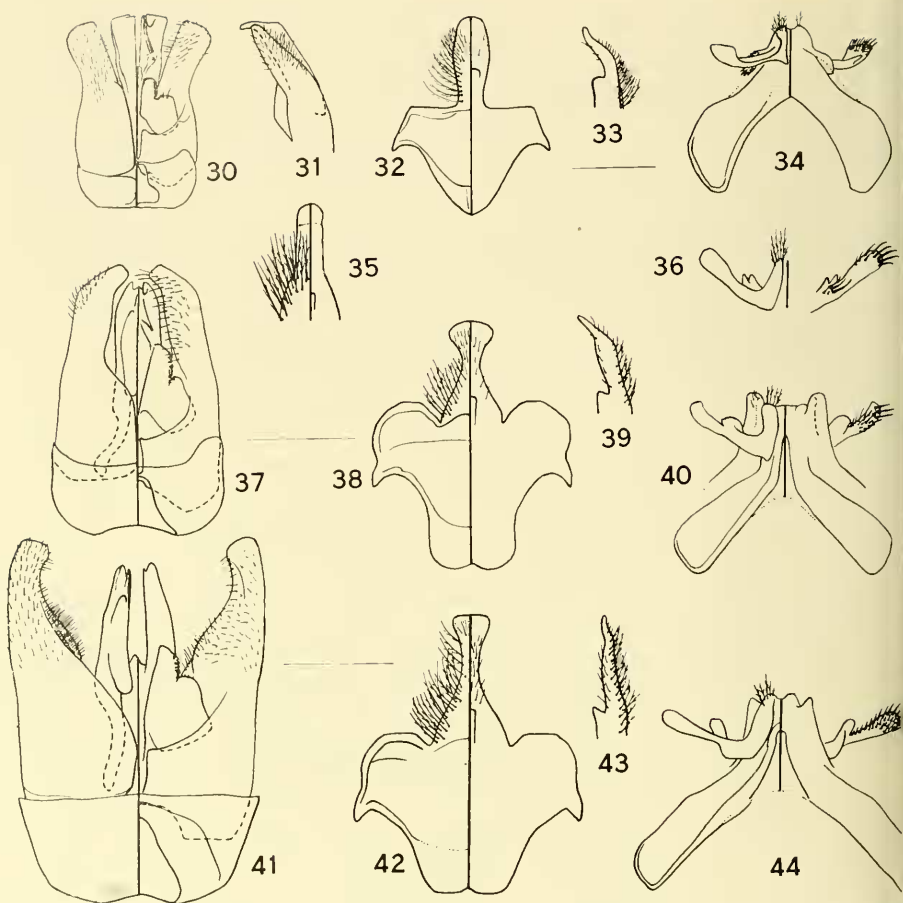
Caupolicana elegans Timberlake, 1965, Jour. New York Ent. Soc., 73:46.

Male: Length 14-16 mm; wing length $10\frac{1}{2}$ -13 mm.

1. Eyes moderately converging above, upper interocular distance about 1.6 times as long as scape; interocellar distance about 1.5 times maximum ocellar diameter; ocellocular distance slightly less than half an ocellar diameter. 2. Genitalia and hidden sterna similar to those of *clypeata*, the most conspicuous difference being that the penis valves are widest medially. 3. Integument black, underside of flagellum apically, tegula, and distal parts of tarsi light brown; fore and middle legs sometimes brownish; margins of metasomal segments broadly translucent. 4. Pubescence ochraceous, scattered dusky hairs on face along inner orbits (scarcely noticeable in type) and some fuscous hairs on vertex (not in type); hairs of dorsum of metasomal terga 2 to 4 black or fuscous, those of 5 and 6 reddish fuscous, posterior margins of terga 2 to 5 with bands of white appressed hair, these bands present only laterally on 2 and 3, broken medially on 4, and continuous on 5; hairs of outer surfaces of middle and hind tibiae and hind basitarsus blackish.

Female: Length 17 mm; wing length $11\frac{1}{2}$ mm.

5. Interocellar distance over twice maximum ocellar diameter. 6. Integumental coloration as in male (character 3) but fore and middle legs black except for brownish small segments of tarsi. 7. Pubescence of head and thorax as described for *clypeata*. Pubescence of metasoma as described for *clypeata* but hairs of first tergum with dusky apices; sternal pubescence slightly paler, the very long hair at sides of sterna 3 and 4 whiter and more extensive; white fasciae on terga 2 to 4 broken medially, that on 4 narrowly so; hairs of terga



FIGS. 30-34, *Caupolicana (Zikanapis) clypeata*, male. 30, genitalia; 31, lateral view of apical part of same; 32, eighth sternum; 33, lateral view of apical process of same; 34, seventh sternum.

FIGS. 35-36, *Caupolicana (Alayoapis) notabilis*, male. 35, apical process of eighth sternum; 36, apical processes of seventh sternum. These drawings were sketched from dry preparations in the British Museum (Natural History).

FIGS. 37-40, *Caupolicana (Alayoapis) subaurata*; 41-44, *C. (A.) nigrescens*; males. For each species structures are genitalia (somewhat flattened artificially in *nigrescens*), eighth sternum, lateral view of apical process of same, and seventh sternum.

For further explanation see Figures 6-9. The scale lines do not apply to Figures 35 and 36.

5 and 6 largely reddish black. Hairs of legs as in *clypeata* but those of outer surfaces of middle and hind tibiae and tarsi black.

This species was described from one male taken near Portal, Cochise County, Arizona, at about 10:00 a.m. It is preserved in the American Museum of Natural History and was lent me for study by Dr. J. G. Rozen, Jr. It is smaller than the other specimens and with less dark hair on the head.

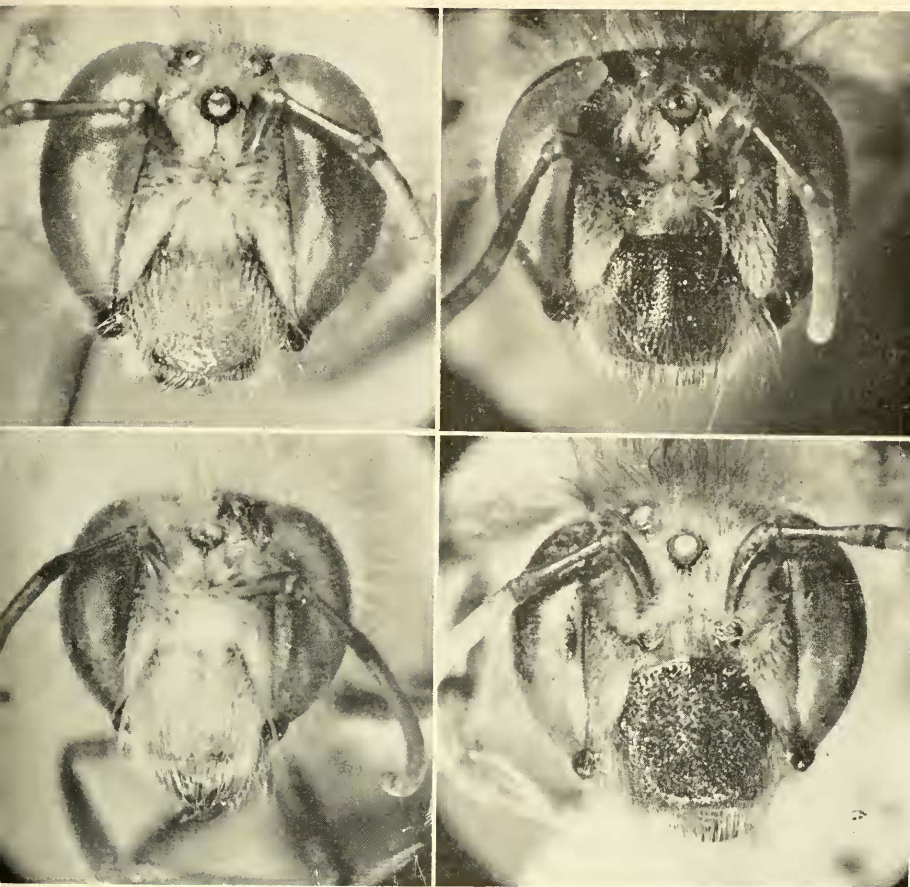


FIG. 47. Faces of North American species of the subgenus *Zikanapis*, females at right. Above, *C. (Z.) clypeata*; below, *C. (Z.) elegans*.

The only other known specimens are a pair taken on highway 150, 37 miles west of Tehuacán, Puebla, Mexico, August 31, 1962, on flowers of *Salvia*, the male at 6:00 p.m., the female at 6:40 p.m. (D. H. Janzen).

D4. THE SPECIES OF ALAYOAPIS

This subgenus is known from three species, the only Antillean representatives of the subfamily, which are characterized below:

Caupolicana (Alayoapis) nigrescens (Cresson)

Megacilissa? nigrescens Cresson, 1869, Trans. Amer. Ent. Soc., 2:295.

Male: Length 15-16 mm; wing length 13-14 mm.

1. Eyes very strongly converging above, upper interocular distance less

than length of scape, eyes closest at point over an ocellar diameter behind ocelli; interocellar distance about equal to ocellar diameter; ocellocular distance less than one sixth ocellar diameter. 2. Front coxa not spined; front femur about three times as long as wide. 3. Front tibia about 4.4 times as long as broad with some hairs as long as tibial diameter. 4. Middle femur with hair much shorter than that on other femora; femur not contorted. 5. Mediotarsal segments of middle leg nearly symmetrical. 6. Inner hind tibial spur gently curved medially. 7. First sternum with median apical spine; second and third sterna with margins recurved. 8. Hidden sterna and genitalia as shown in Figures 41 to 44. 9. Black, flagellum dark brown beneath, paler apically, apex of last segment reddish. Legs brown to reddish, more or less infuscated, coxae, trochanters, mediotarsi and distitarsi blackish. Tegula piceous to black. Wings brownish, slightly darker than in *yarrowi*. 10. Hair of face mixed black and white. Hair of vertex black, of occiput, genal areas, and under side of head white. Hair of prothorax white, blackish on posterior lobe of pronotum. Mesonotum with hair dark gray to blackish except for broad white band across front of scutum, narrower white band along scuto-scutellar suture, and white along posterior edge of scutellum and along lateral edge of scutum mesad from tegula. Pleural and ventral areas of thorax with dark gray to blackish hairs except for large dull white lateroventral mesepisternal area and dull white on metapleuron. Metanotum and posterior part of propodeum with white hairs, long dorsolateral hairs of propodeum partly black. Coxae and middle and hind trochanters with hairs dark gray to black; rest of legs with hairs pale yellowish in some lights, blackish in others, darkest on posterior femora, forelegs with the most yellowish. First tergum with hairs white anteriorly and laterally, black dorsally, with a small dorsolateral indication of apical white band. Remaining terga with hairs black, white at extreme sides of second, short on terga 2 to 4 with narrow, bright, white apical bands (narrower than in *yarrowi*). First sternum with hair white, others with hair dark gray.

Female: Length 16-18 mm; wing length 11 mm.

11. Basal part of labrum raised to form two strong longitudinal submedian carinae. 12. Maximum ocellar diameter less than ocellocular distance which is subequal to interocellar distance. 13. Apical spine of strigilis shorter than rest of strigilis. 14. Integumental coloration as described for male (character 9) but hind leg more consistently black. 15. Hair of face mixed black and white, sparse on shining (but punctured and minutely roughened) clypeal disc; median part of frons with hairs all white; hair of vertex black forward to and including transverse band of dense black hair between anterior and posterior ocelli, wholly black hair extending down in upper paraocular areas; subapical fringe of clypeus and lower fringe of mandible rufescent fuscous; genal and hypostomal areas with hair white. Thoracic pubescence (in poor condition in

available specimen) has a pattern similar to that of male. Hairs of legs black, reddish on fore legs and small segments of tarsi; femoral scopa white. Tergal pubescence as described for male but white band of tergum 2 present only laterally, of 3 broken medially. Sternal pubescence dusky reddish, whitish at extreme sides.

Caupolicana nigrescens is most similar to *subaurata*. Characters 1, 2, 4 (contorted femur), 5, 12, and the color differences are among the striking distinguishing features.

This species was described from Cuba without further data but the type, which is still in good condition in the Gundlach collection in Havana, bears the number 293; Dr. Pastor Alayo D. has looked this up in Gundlach's manuscript catalogue and found the notation "Yateras, Ote., XI." It is interesting that the type locality for this species and its relative, *subaurata*, should be the same place in Oriente Province.

Dr. Alayo writes of this species, "These bees are dwellers in the most dense forests of Cuba, specially in the mountains of Oriente Province, and I do not remember to have found any specimen in the lowlands."

Specimens have been studied by me or reported to me by Dr. Alayo (from his collection and that of Dr. F. de Zayas M.) from the following localities, all in Oriente Province, Cuba:

Sierra Cristal, Mayarí, May, 1955 (Zayas); Piloto, Moa, June, 1954 (Zayas and Alayo); Loma del Gato, Hongolosongo, Sierra del Cobre, June, July, September (Zayas and Alayo); same locality, September, 1935, October 1-2, 1935, 2600 to 3325 feet altitude (J. Acuña, S. C. Bruner, L. C. Scaramuzza, collectors); Pico (or Alto de) Cardero, Macizo del Turquino, June, 1963 (Alayo).

Caupolicana (Alayoapis) subaurata (Cresson)

(Figs. 37-40, 45, 48)

Megacilissa? subaurata Cresson, 1869, Trans. Amer. Ent. Soc., 2:296.

Male: Length 16 mm; wing length 13½ mm.

1. Eyes strongly converging above, upper interocular distance greater than length of scape, eyes closest at point less than ocellar diameter behind ocelli; interocellar distance greater than ocellar diameter; ocellular distance over one fourth ocellar diameter. 2. Front coxa with short apical spine; front femur of male less than three times as long as wide. 3. Front tibia about four times as long as broad with some hairs nearly as long as tibial diameter. 4. Middle femur with hair much shorter than that on other femora; femur contorted (Fig. 45). 5. Mediotarsal segments of middle leg with posterior lobes much larger than anterior lobes. 6. Inner hind tibial spur strongly curved medially. 7. As in *nigrescens*. 8. Hidden sterna and genitalia as shown in Figures 37 to 40. 9. Black, flagellum as in *nigrescens*. Legs red, mediotarsi blackish, especially on mid and hind legs. Tegula reddish brown. Wings as in *nigrescens*.

10. Hair color pattern as in *nigrescens* but pale hair ochre instead of white, dark hairs dark only apically so that gray color is light and somewhat ochraceous, pale band on scuto-scutellar suture weak, pale ventrolateral mesepisternal area larger than in *nigrescens* so that midventral dark region is reduced and ventral and lateral pubescence of thorax may appear entirely ochraceous; hairs of legs ochreous. First metasomal tergum with ochraceous hairs anteriorly and laterally, gray or blackish dorsally except for complete narrow apical band of white. Remaining terga with black hairs, becoming reddish on 5 and 6 and extreme sides of 2, narrow apical white bands (narrower than in *nigrescens*) on 2-4 as well as 1. Sterna 1 and 2 with ochraceous hair, others with light ochreous gray hair.

Female: Length 17 mm; wing length 11 mm.

11. Basal part of labrum raised to form two strong longitudinal submedian carinae. 12. Maximum ocellar diameter about equal to ocellocular distance which is less than interocellar distance. 13. Apical spine of strigilis longer than rest of strigilis. 14. Integumental coloration as in male (character 9). 15. Pubescence of head as described for female *nigrescens* but pale hairs ochraceous, dark ones mostly dusky rather than black, at least basally; transverse band of dense hair between ocelli mixed dark and light, as are hairs of upper paracocular areas; subapical fringe of clypeus and lower fringe of mandible coppery. Thoracic hair coloration as in male, the striking pattern of *nigrescens* being only weakly evident. Hair of legs ochreous, even fulvous on tibiae and basitarsi. Tergal pubescence as described for male. Sternal pubescence dusky reddish, fulvous laterally.

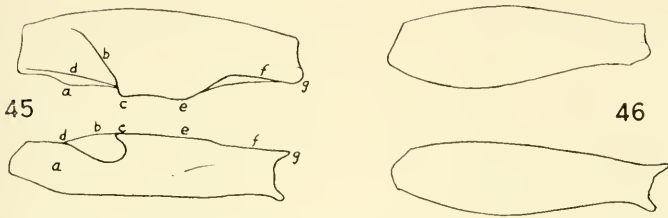
This species is closest to *C. nigrescens*. The most distinctive features are listed under that species.

This species was described from Cuba without further data. The type, which is in good condition in the Gundlach collection in Havana, bears the number 292. Dr. Pastor Alayo D. has found that this number in Gundlach's manuscript catalogue refers to the notation "Yateras. Ote., XI." This is also the type locality for *nigrescens* although other records are for localities different than those where *nigrescens* has been taken. *Caupolicana subaurata* may well be wider ranging both ecologically and geographically than *nigrescens*.

Specimens have been studied by me or reported to me by Dr. Alayo (from his collection and that of Dr. F. de Zayas M.) from the following localities:

Oriente Province: Puerto Boniato, Santiago de Cuba, October, 1943 (Alayo); Moa, Baracoa, June, 1954 (Alayo and Zayas); Capitolio, Río Yara, 1150 feet altitude, May 18, 1948 (Zayas).

Pinar del Río Province: Mogote de Xyla, Couret, carretera a Luis Lazo, November, 1956 (Jaume); San Vicente, Viñales, May, 1956 (Alayo and Zayas); Sierra Cajálbina, June, 1956 (Zayas); Rancho Mundito, Sierra Rangel, June, 1950 (Zayas).



FIGS. 45-46, Posterior and ventral views of middle femora of males of Cuban *Alayoapis*. Posterior views are above, with the dorsal surfaces uppermost; ventral views are below with the anterior surfaces uppermost. 45. *C. (A.) subaurata*; like letters indicate like localities. 46. *C. (A.) nigrescens*.

Caupolicana (Alayoapis) notabilis (Smith)

Megacilissa notabilis Smith, 1861, Jour. Ent., 1:149.

Male (the following is based on notes made from male type in the British Museum):

1. About as in *nigrescens*. 2. Front coxa not spined; front femur less than three times as long as wide. 3. Front tibia about six times as long as broad, with only very short hairs. 4. Middle femur with hair rather long and dense like that of hind femur; femur not contorted. 5. Not seen. 6. Inner hind tibial spur nearly straight. 7. First sternum not spined; second and third sterna with margins transverse. 8. Hidden sterna as in *subaurata* except as shown in Figures 35 and 36; genitalia as in *subaurata* but distal halves of parameres densely covered on dorsal and outer surfaces with black, plumose hairs (cleared preparation not made). 9. Black, legs and tegula dark brown, presumably faded from blackish. Wings light brownish, slightly darker apically than in *yarrowi*. Integument of metasoma red. 10. Hair of head white, light brownish on vertex, lower part of clypeus, and mandibles; intermixed long fuscus hairs on these areas and elsewhere below antennae; a tuft of fuscous or black hairs near eye margin at level of anterior ocelli. Hair of thorax gray, fuscous or darker gray on anterior lateral parts of scutum, anterior face of mesepisternum, scutellum, and posterior parts of sides of thorax; coxae and trochanters and much of anterior femora with gray hair, rest of hair of legs mostly fuscous. Metasomal hair fuscous, that of first segment gray ventrally and laterally.

Female: Length 17-19 mm; wing length 12-13½ mm.

11. Basal part of labrum with broad even median convexity. 12. Maximum ocellar diameter less than ocellocular distance which is slightly less than inter-ocellar distance. 13. Apical spine of strigilis about as long as rest of strigilis. 14. Integumental coloration as in male (character 9) (tegula and legs blackish in more recently collected material). 15. Hair of head as described for female *nigrescens* but with some white hairs around ocelli and intermixed black hairs on genal and hypostomal areas. (Black hairs only dusky in female from Brit-

ish Museum approximately as old as male type.) Hair of thorax as in male, varying to all nearly black. Hair of legs black or nearly so, reddish on under sides of some tarsal segments, scopa grayish because axes of hairs are black but branches colorless. Metasomal hair as in male but fuscous hairs black in fresher material.

This species is known only from the Dominican Republic in the island of Hispaniola. The type which is a male, and one female, both from Santo Domingo, are in the British Museum. Six females in the United States National Museum were taken at Constanza, Dominican Republic, May 27, 1927 (A. Wetmore). Dr. Wetmore writes (*in litt.*) that his collecting was at about 4000 feet altitude in an area of pines mixed with patches of rain forest. The bees were collected near midday, on flowers growing in an opening among the pines.

LITERATURE CITED

- COCKERELL, T. D. A. AND WILMATTE PORTER. 1899. Contributions from the New Mexico Biological Station—VII. Observations on bees, with descriptions of new genera and species. *Ann. Mag. Nat. Hist.* (7)4:403-421.
- FOX, W. J. 1898. (No title). *Ent. News* 9:128.
- FRIESE, H. 1898. Monographie der Bienengattungen *Megacilissa*, *Caupolicana*, *Diphaglossa* und *Oxaea*. *Ann. K. K. Naturhist. Hofmus.* [Wien] 13:59-86.
- GRAENICHER, S. 1930. Bee-fauna and vegetation of the Miami Region of Florida. *Ann. Ent. Soc. Amer.* 23:153-174.
- LINSLEY, E. G. 1960. Observations on some matinal bees at flowers of *Cucurbita*, *Ipomoea* and *Datura* in desert areas of New Mexico and Southeastern Arizona. *Jour. New York Ent. Soc.* 68:13-20.
- . 1962. Sleeping aggregations of aculeate Hymenoptera—II. *Ann. Ent. Soc. Amer.* 55:148-164.
- LINSLEY, E. G. AND M. A. CAZIER. 1963. Further observations on bees which take pollen from plants of the genus *Solanum* (Hymenoptera: Apoidea). *Pan-Pac. Ent.* 39:1-18.
- LINSLEY, E. G. AND P. D. HURD. 1959. Ethological observations on some bees of southeastern Arizona and New Mexico (Hymenoptera: Apoidea). *Ent. News* 70:63-68.
- MICHENER, C. D. 1944. Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera). *Bull. Amer. Mus. Nat. Hist.* 82:151-326.
- . 1954. Bees of Panamá. *Bull. Amer. Mus. Nat. Hist.* 104:1-176.
- MOURE, J. S. 1945. Contribuição para o conhecimento dos Diphaglossinae, particularmente *Ptiloglossa* (Hym.-Apoidea). *Arq. Mus. Paranaense* 4:137-178.
- . 1953. Notes sobre Colletidae Sul-Americanos (Hymenoptera-Apoidea). *Dusenía* 4:61-78.
- . 1964. As espécies de *Zikanapis*, com a descrição de dois novos subgêneros e duas espécies novas (Hymenoptera, Apoidea). *Studia Ent.* (n.s.) 7:417-458.
- SELANDER, R. B. AND P. VAURIE. 1962. A gazetteer to accompany the "Insecta" volumes of the "Biologia Centrali-Americana." *Amer. Mus. Novitates* 2099:1-70.



FIG. 48. Faces of the subgenera *Alayoapis* and *Caupolicanoides*, females at right. Above, *C. (A.) nigrescens*; center, *C. (A.) subaurata*; below left, *C. (C.) pubescens* male (from Concepción, Chile, labeled as "typus" of *herbsti* by Friese, USNM); below right, *C. (A.) notabilis*, female.